Regional Carbon Capture, Transport, and Storage Opportunities in Louisiana

October 19, 2021

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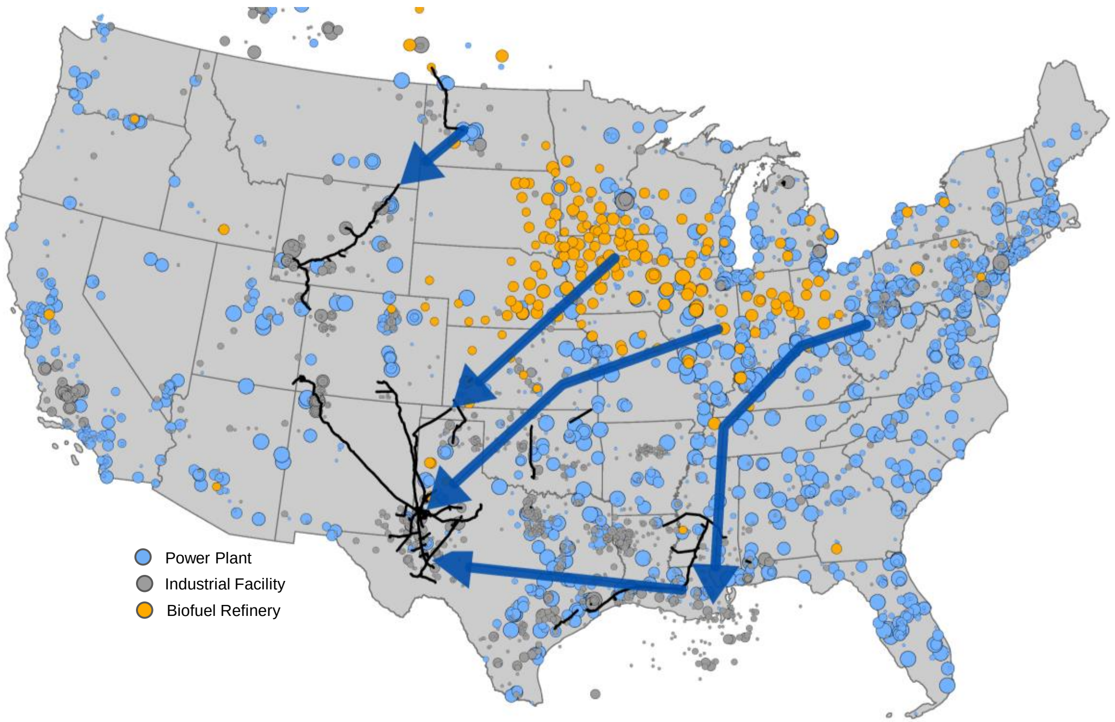
Regional CO_2 Transport Infrastructure Study

Study Components

1. Identify near-term opportunities for CO_2 capture retrofit
2. Locate areas of CO_2 storage and use
3. Model optimized CO_2 transport infrastructure to maximize capture and storage

Initial CO_2 Corridor Scoping



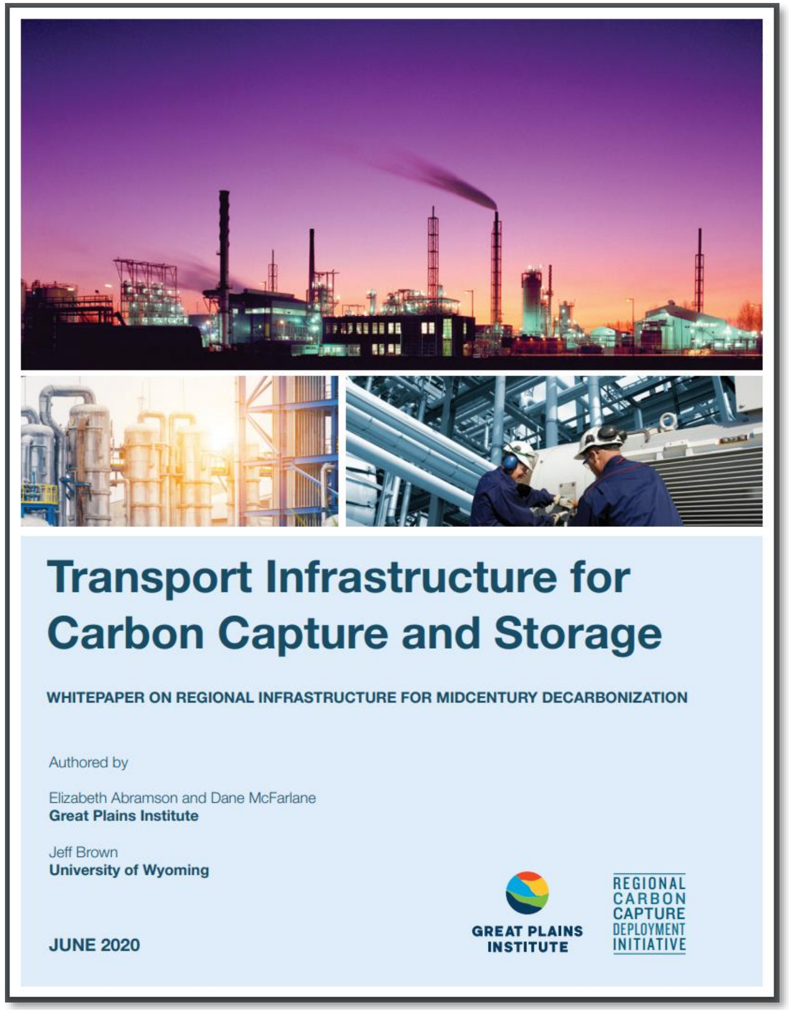
Primary Partners:

Regional Carbon Capture Deployment Initiative
Los Alamos National Laboratory Est. 1943
Montana State University
B2E2 Brown Brothers Energy & Environment
Indiana University
Stanford University

Great Plains Institute

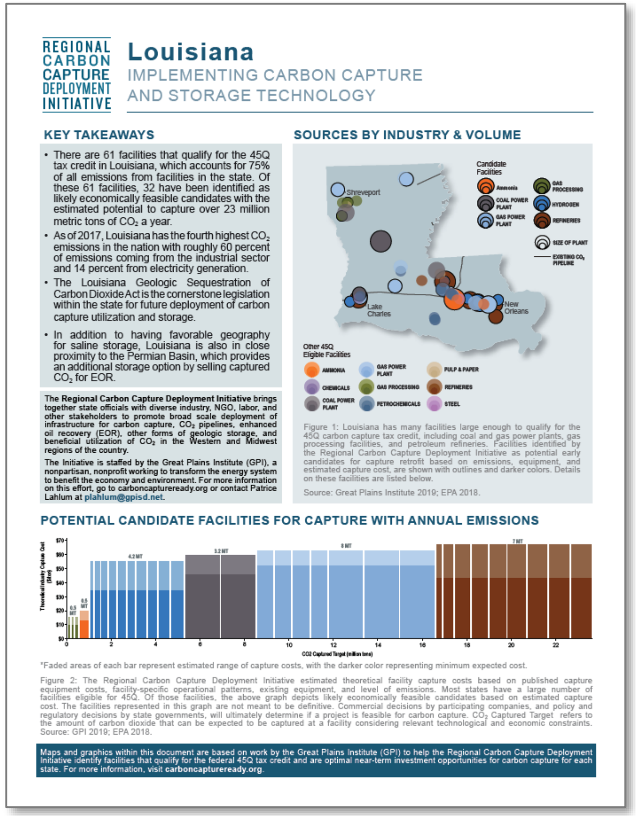
Analytical Report

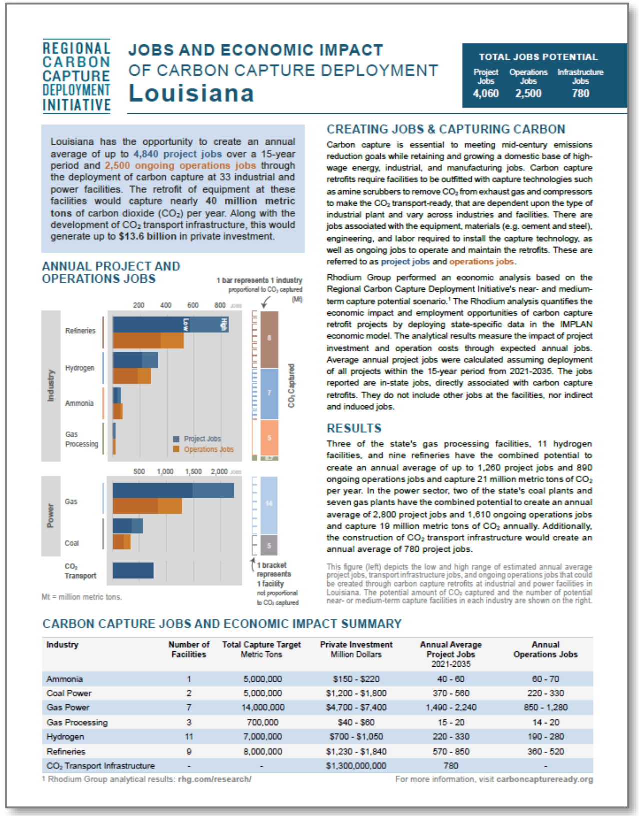
Published in 2020



Economic Impact & Jobs Study

Rhodium Group 2020-21





Industry	Number of Facilities	Total Capture Target Metric Tons	Private Investment Million Dollars	Annual Average Project Jobs 2021-2035	Annual Operations Jobs
Ammonia	1	5,000,000	\$150 - \$220	40 - 60	60 - 70
Coal Power	2	5,000,000	\$1,200 - \$1,800	370 - 560	220 - 330
Gas Power	7	14,000,000	\$4,700 - \$7,400	1,490 - 2,240	850 - 1,280
Gas Processing	3	700,000	\$40 - \$60	15 - 20	14 - 20
Hydrogen	11	7,000,000	\$700 - \$1,050	220 - 330	190 - 280
Refineries	9	8,000,000	\$1,230 - \$1,840	570 - 850	360 - 520
CO_2 Transport Infrastructure	-	-	\$1,300,000,000	780	-

1 Rhodium Group analytical results: rhg.com/research/

For more information, visit carboncaptureready.org

- 36,000 – 54,200 average jobs per year over 15 years
- 7,000+ jobs in Louisiana

Download paper and state fact sheets at:

carboncaptureready.org/analysis

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UN IPCC: 1.5°C Scenario Carbon Budget

Time is running out for moderately achievable reductions

Delayed action past 2020s will require extreme reductions that can only be achievable through “negative” emissions.

Global Carbon Budget for 1.5°C Temperature Change

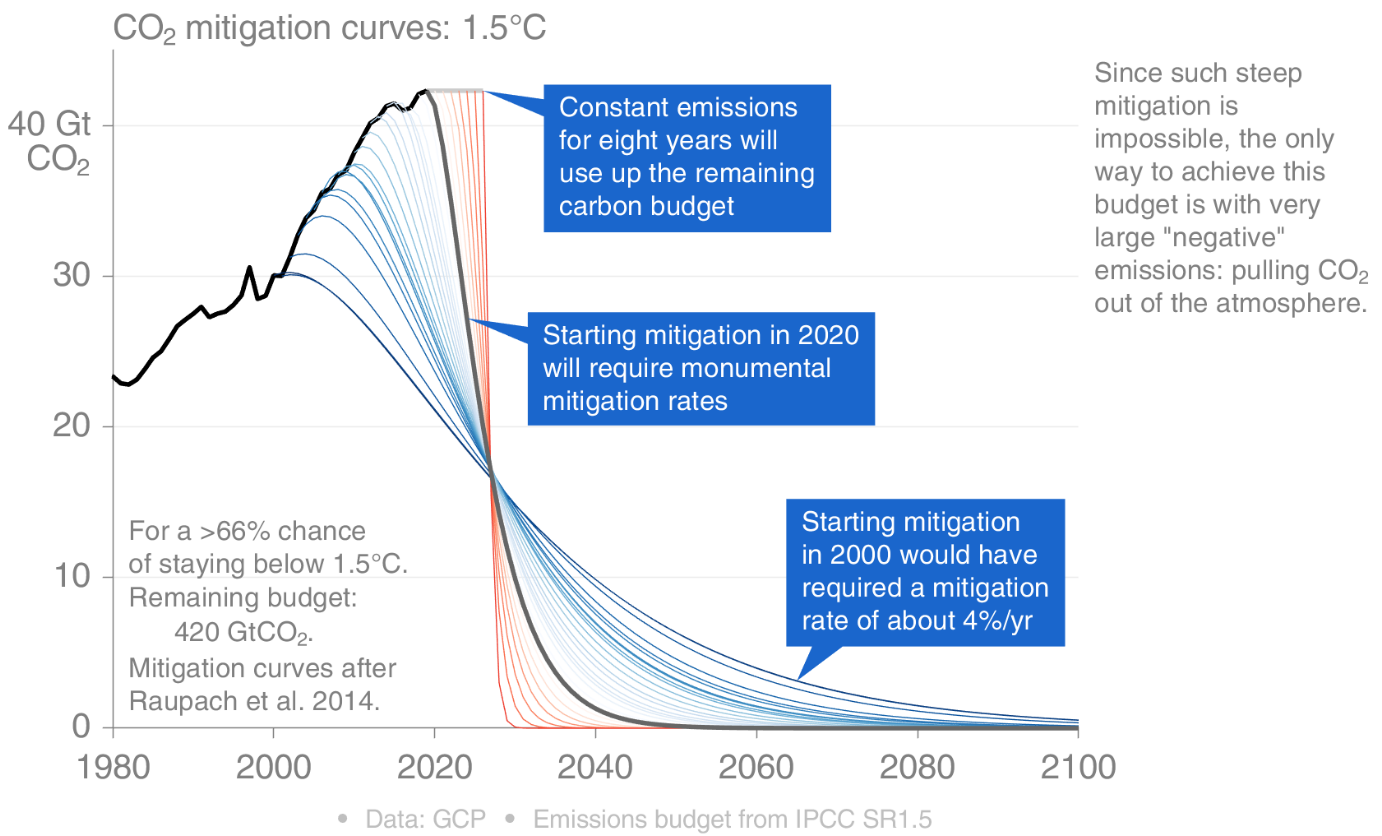

Figure by Robbie Andrew
https://folk.universitetetioslo.no/roberan/RobbieAndrew.shtml

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UN IPCC 2019:

Steepest reductions in fossil fuel and industry must occur before 2040

Global target:
Net-Zero 2050

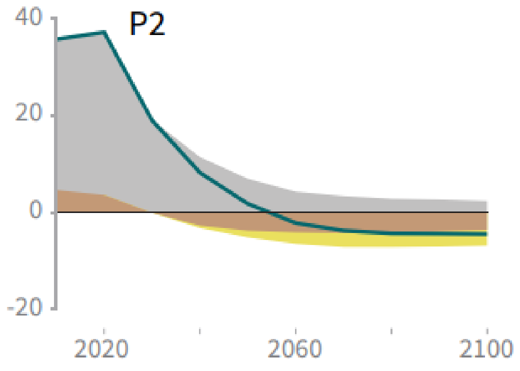
IPCC:
Global GHG reduction of 45% needed by 2030 (more if we don't act now) for 1.5°C to 2°C.

Reductions must begin in the 2020s and achieve **fastest pace in the 2030s**.

Delayed action increases need for negative emissions from capture and storage.

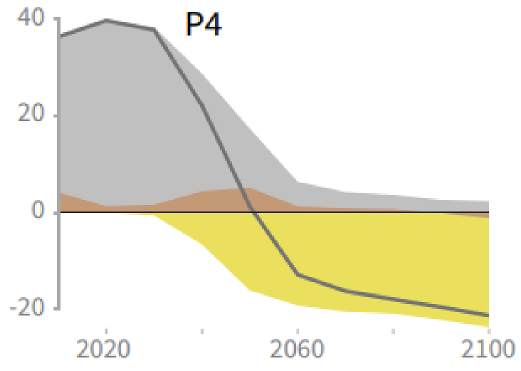
Steep, early reductions.

Carbon storage through ag and forestry, bioenergy, and carbon capture.



Delayed, slow reductions.

Extreme levels of carbon capture, negative emissions, and bioenergy



Fossil fuel and industry AFOLU Negative emissions

AFOLU: Agriculture, farming, and other land use

Source: IPCC 2019

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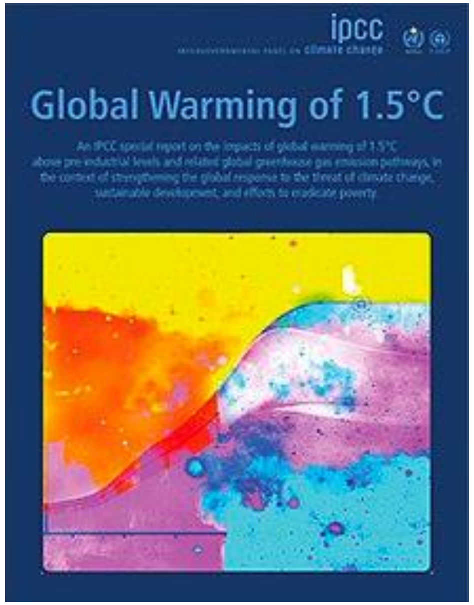
Carbon Capture is essential to meeting mid-century decarbonization goals — and doing so affordably

IPCC 5th Assessment:

Meeting 2° C goal costs 138% more without carbon capture.

IPCC 1.5 C modeling:

Atmospheric CO_2 removal through direct air capture and bioenergy with carbon capture is needed—in addition to **economywide industrial carbon capture.**



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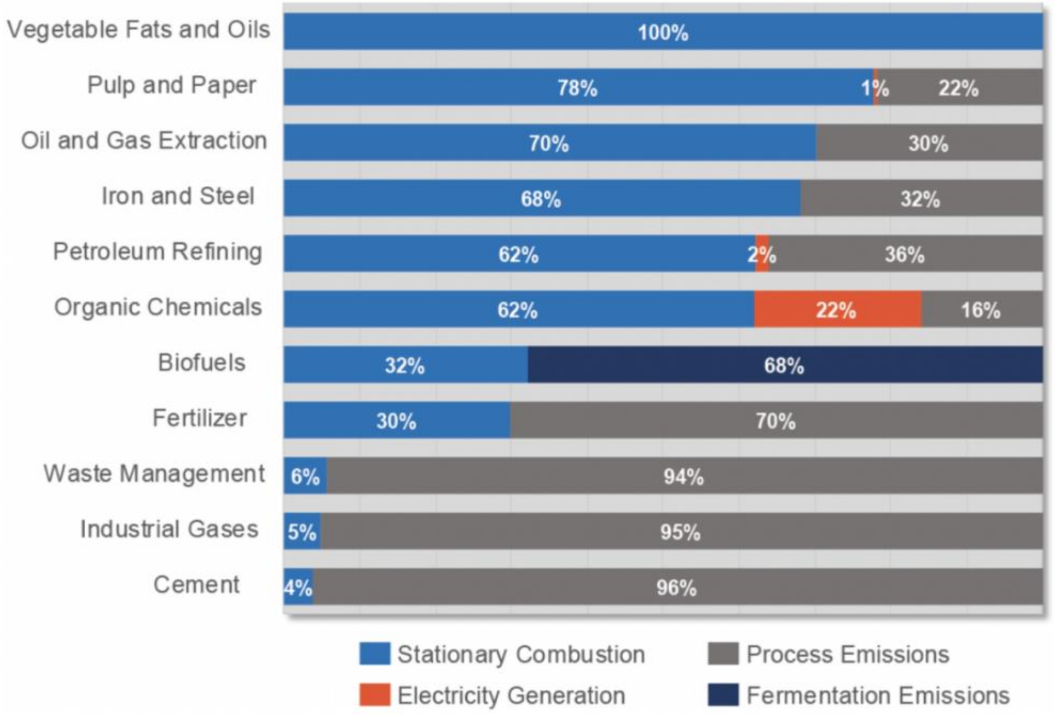
U.S. Industrial Sector Emissions

Industrial Process Emissions

- Process emissions result from the manufacture of products
- Not strictly related to energy use
- Often the result of chemical processes that release CO_2
- Hard to decarbonize without carbon capture or new techniques

Emissions	Reduction Strategy
On-site combustion:	Electrification & Fuel Switching
Process Emissions:	Carbon Capture; R&D and New Technology
Indirect Emissions:	Decarbonizing Electric Grid

Direct Emissions: U.S. Midcontinent Facilities



Figures authored by Elizabeth Abramson, Great Plains Institute, 2020
Source: EPA 2018

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CO_2 Capture Opportunities: Industrial and Power Facilities

Section 45Q
Tax Credit for CO_2 Storage

Geologic Saline: $50 / ton
EOR Storage: $35 / ton

Minimum Capture Thresholds

Industrial Facility: 100 thousand tons CO_2
Power Plants: 500 thousand tons CO_2

Near- and Medium-Term Screening Criteria:

- 45Q Eligibility
- Operational patterns
- Expected life
- Right-size capture equipment to specific units within each facility

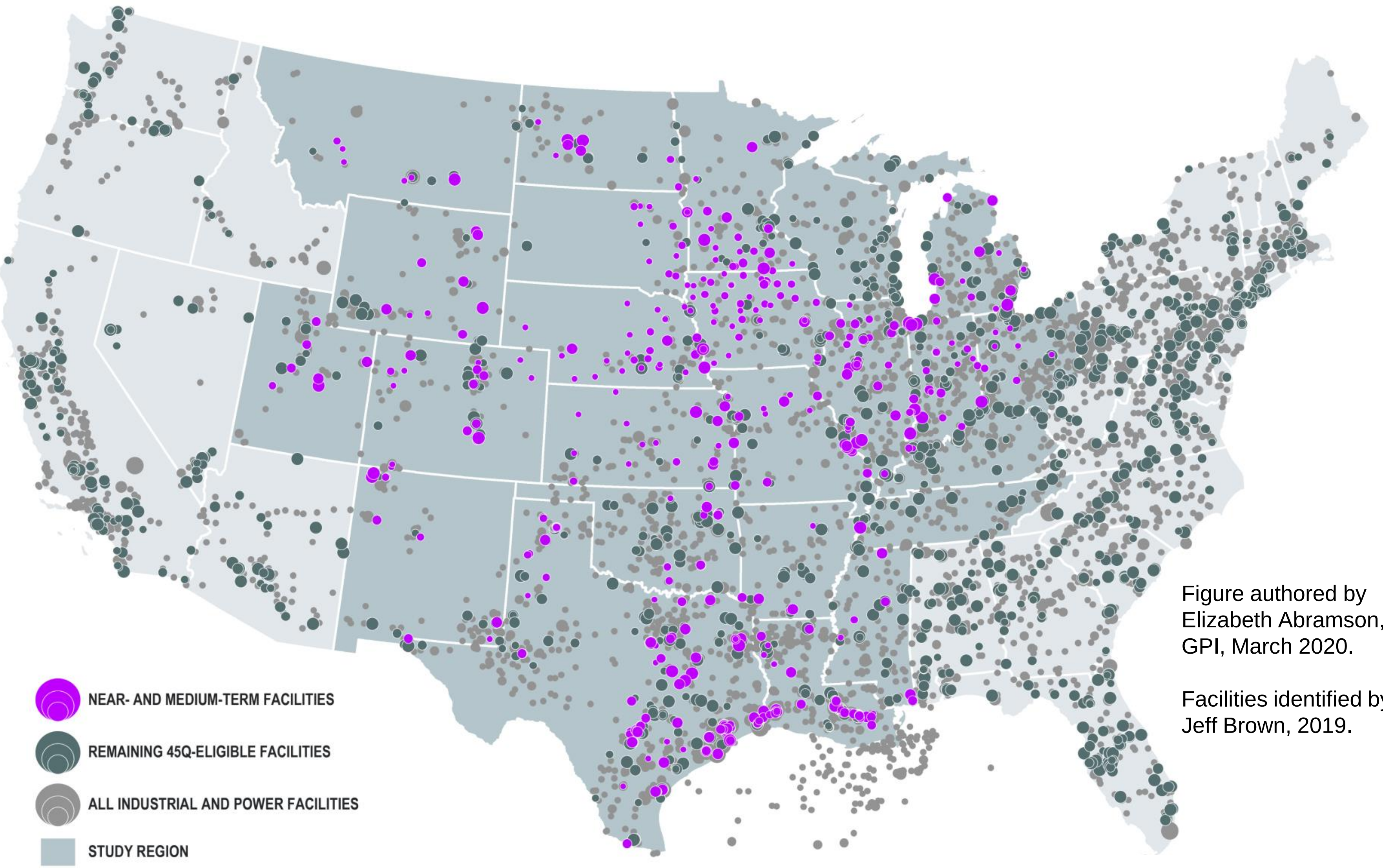

Figure authored by Elizabeth Abramson, GPI, March 2020.

Facilities identified by Jeff Brown, 2019.

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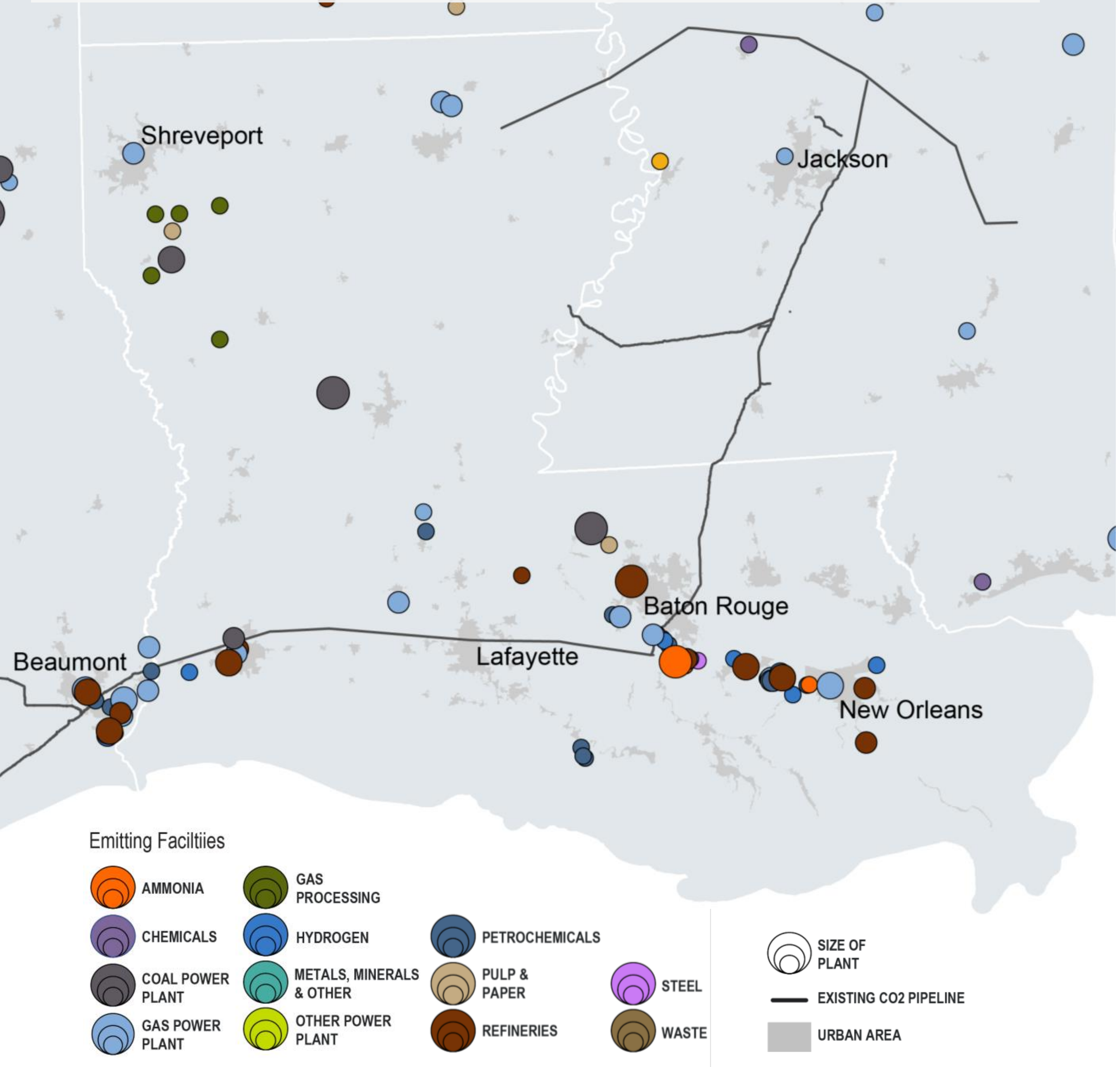
45Q-Qualifying Power and Industrial Sources of CO_2 in Louisiana



Industry	# of 45Q Qualifying Facilities	45Q Qualifying Emissions (million metric tons CO2)	Total # of Facilities in Louisiana	Total Facility Emissions in Louisiana (million metric tons CO2)
Ammonia	4	8.9	4	8.9
Chemicals	1	0.3	31	3.8
Coal Power Plant	4	18.5	4	18.5
Gas Power Plant	12	23.2	26	26.0
Gas Processing	4	0.8	227	11.9
Hydrogen	10	7.4	13	7.6
Metals, Minerals & Other	-	-	25	2.4
Other Power Plant	-	-	1	2.1
Petrochemicals	12	10.2	20	14.2
Pulp & Paper	2	1.4	9	2.8
Refineries	11	30.7	15	32.1
Steel	1	0.1	1	0.1
Waste	-	-	25	-
Grand Total	**61**	**101.4 MMT**	**401**	**130.5 MMT**

MMT: million metric tons CO2

Source: EPA GHGRP 2018

Near- and Medium-Term Opportunity: **23.3 million metric tons CO2**

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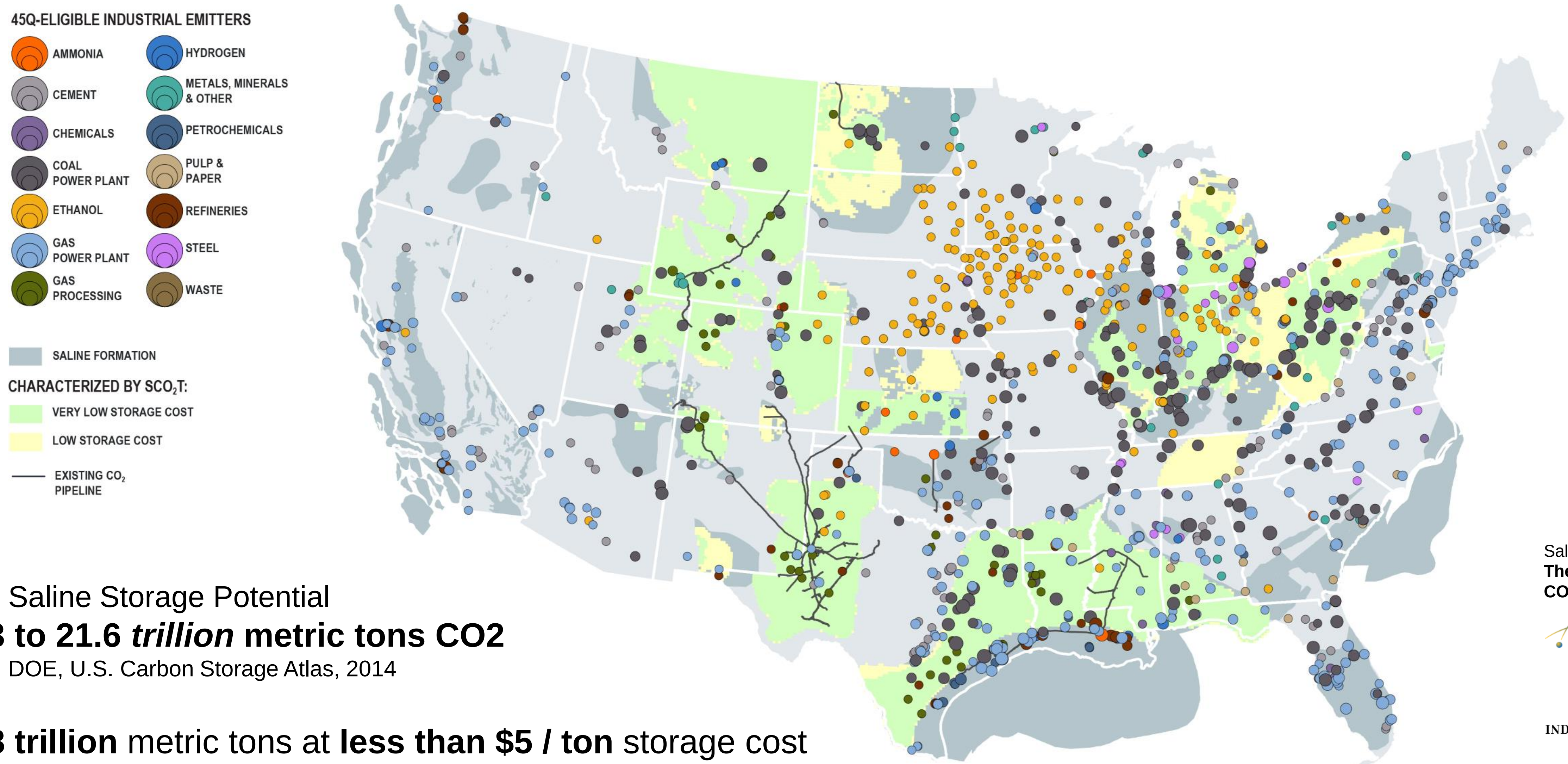
Geologic CO_2 Storage



US Saline Storage Potential

8.3 to 21.6 *trillion* metric tons CO2

U.S. DOE, U.S. Carbon Storage Atlas, 2014

1.8 trillion metric tons at **less than $5 / ton** storage cost

[Conservative estimate based on *partial* coverage of data. National estimate forthcoming.]

Los Alamos National Lab and Indiana Geological Survey, SCO2T Model, 2020

Saline data via
The Sequestration of CO2 Tool (SCO2T)

Los Alamos NATIONAL LABORATORY EST. 1943

INDIANA UNIVERSITY

Figure authored by Elizabeth Abramson, GPI, March 2020

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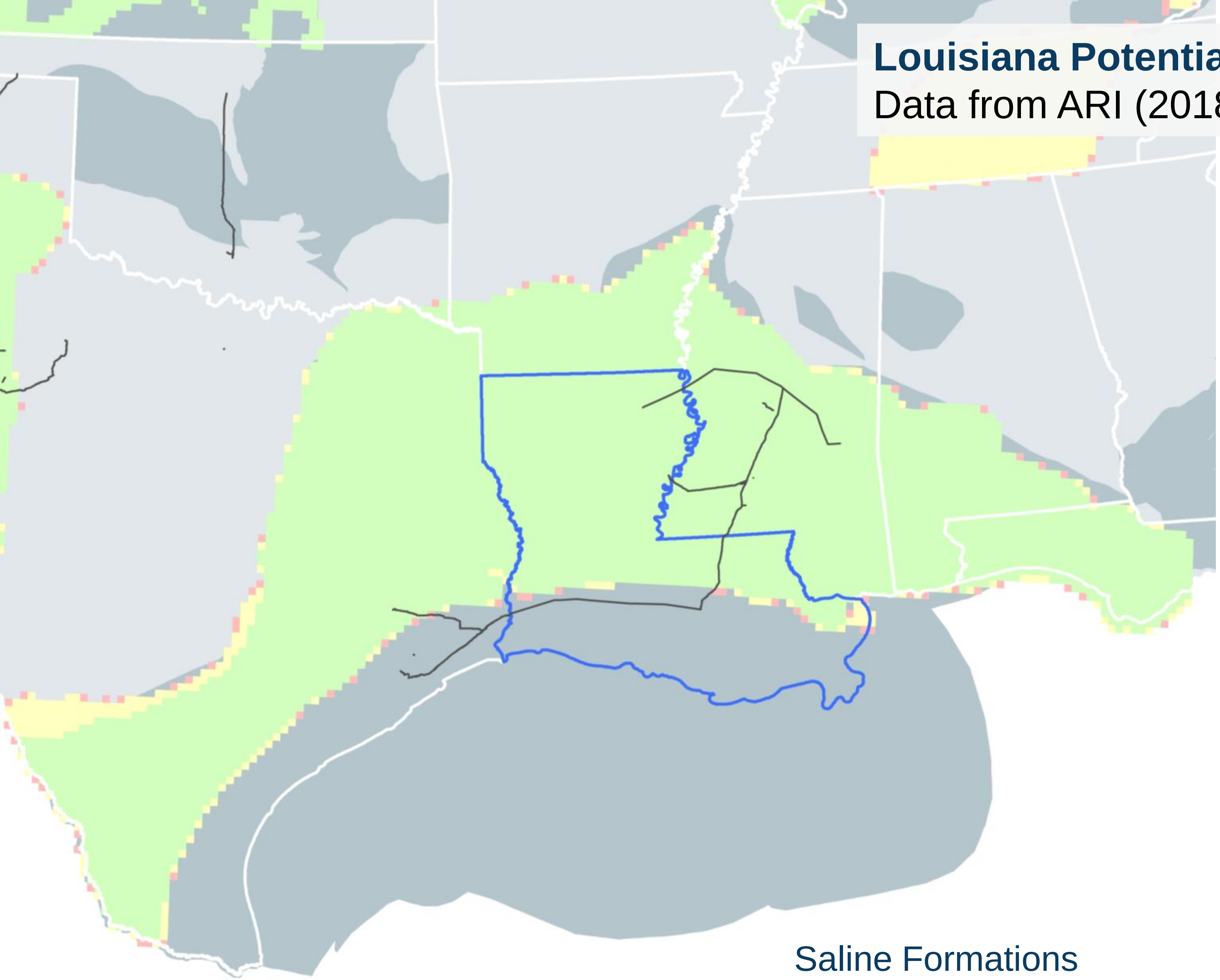
Louisiana Potential CO2 Demand for Enhanced Oil Recovery

Data from ARI (2018)



Potential Import of CO2 into Louisiana

Screened Near and Medium-Term Opportunities, not including later phase 45Q Qualifying Facilities

Supply Region	To Target Region	Economically Feasible Capture
Midwest	Gulf	**48 million tons**
Louisiana	Louisiana	**23 million tons**

Source: GPI 2020

Geologic CO2 Storage Potential in Louisiana

	Technical Potential
Annual:	**2.3** billion metric tons
Total:	**70.3** billion metric tons

Source: DOE NATCARB 2016; SCO2T 2020; GPI 2020.

Saline Formations

- Very Low Cost Storage
- Low Cost Storage
- Moderate to High Cost Storage
- Not Yet Characterized

Oil Fields

- Could purchase CO2 when oil is $40 / bbl
- Could purchase CO2 when oil is $60 / bbl

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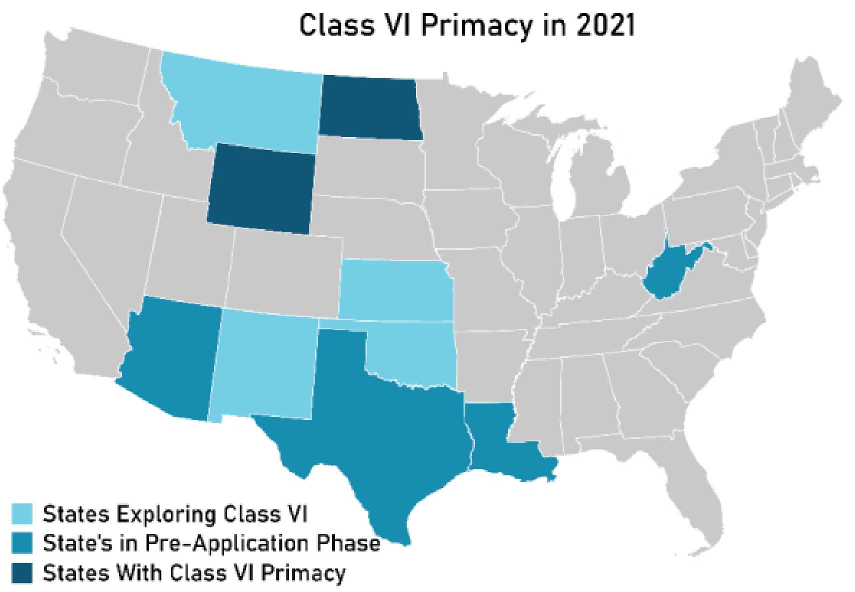
Class VI Primacy for Well Permitting

EPA's Class VI & the Underground Injection Control (UIC) Program

- Regulatory framework to ensure that large volumes of CO_2 captured from industrial facilities, power plants and ambient air can be safely and securely stored underground long-term.
- Requirements for well siting, permitting, operation, testing and monitoring, post-injection site care and site closure.
- Reporting under GHGRP Subpart RR is required for all facilities with a Class VI permit.

Federal and State Capacity

- EPA has only recently increased staff capacity to respond to Class VI permitting needs
- EPA reports more than 50 Class VI permitting inquiries
- Interested states may be able to act faster with primacy while following the UIC regulatory framework
- 8 states have convened around Class VI Primacy issues
- Bipartisan Scale Act (H.R. 1992, S. 799) would increase EPA funds for Class VI permitting and provide grants for state programs



- **North Dakota** and **Wyoming** have been granted *primacy* to regulate Class VI through state departments
- **Louisiana** has applied for Class VI Primacy, with **approval expected in 2022**.

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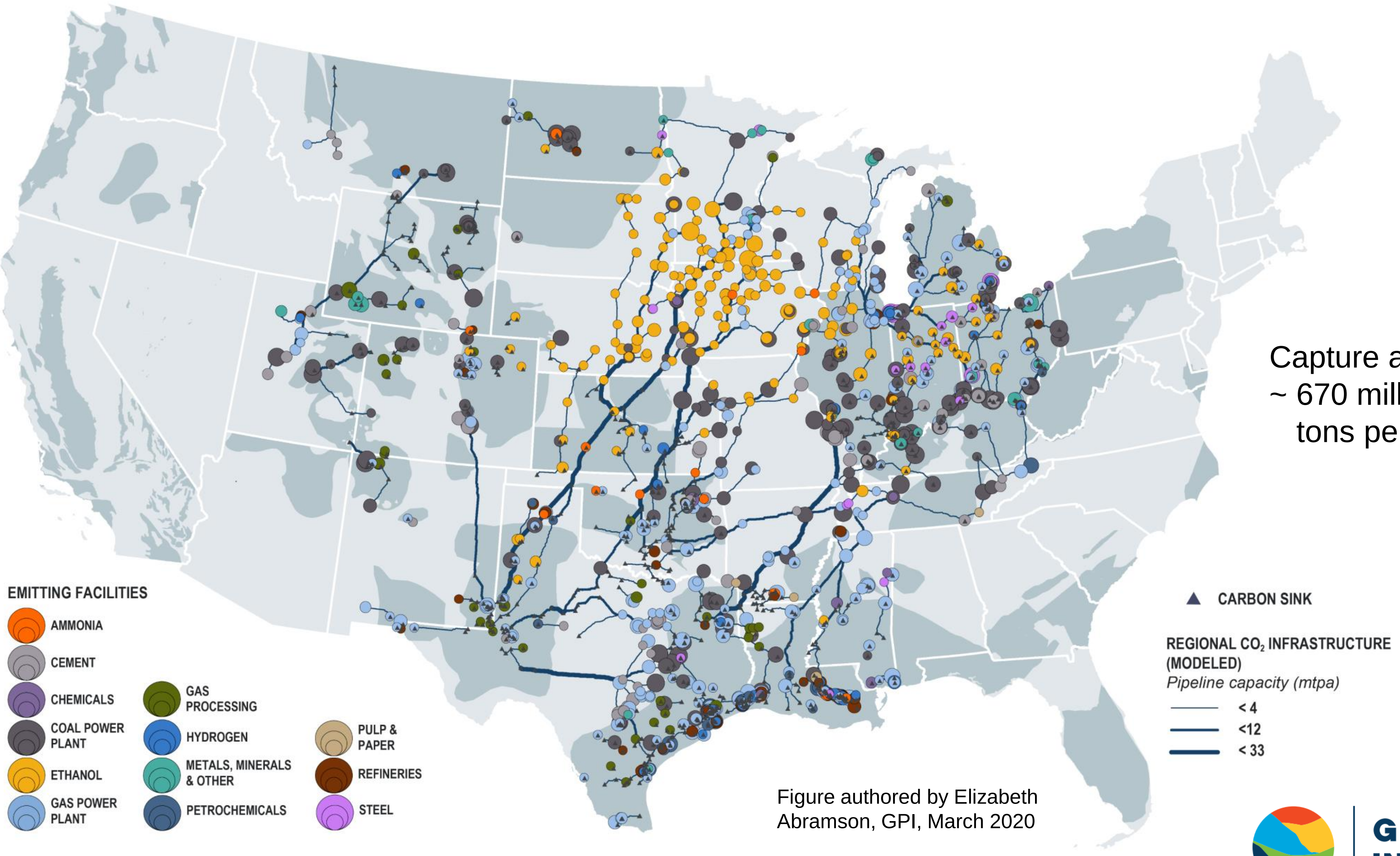
CARBON CAPTURE COALITION

Midcentury: Long-term Economy-Wide Deployment
Expanded storage in saline formations and petroleum basins



Capture and storage:
~ 670 million metric tons per year

Figure authored by Elizabeth Abramson, GPI, March 2020

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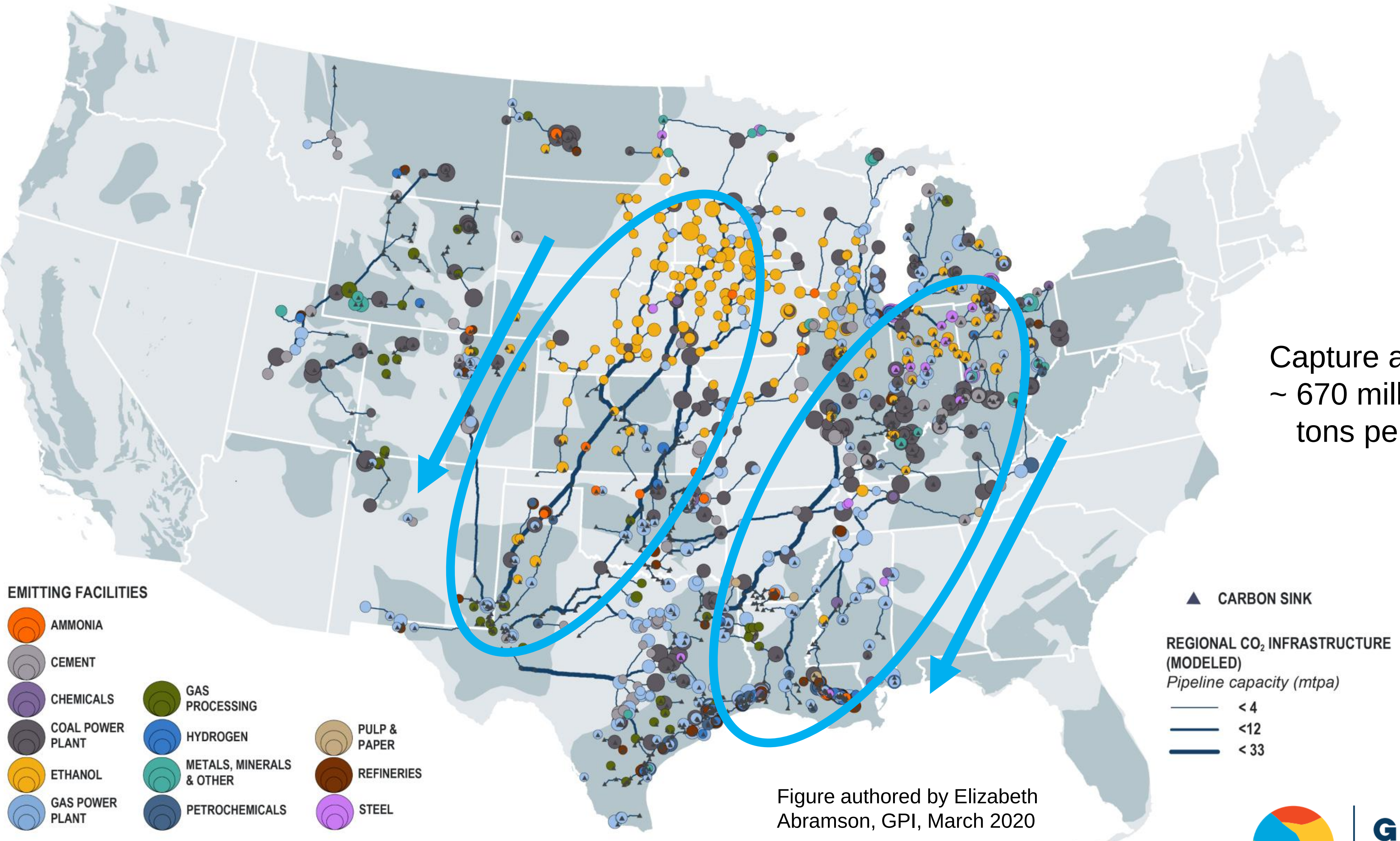

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Thank You

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